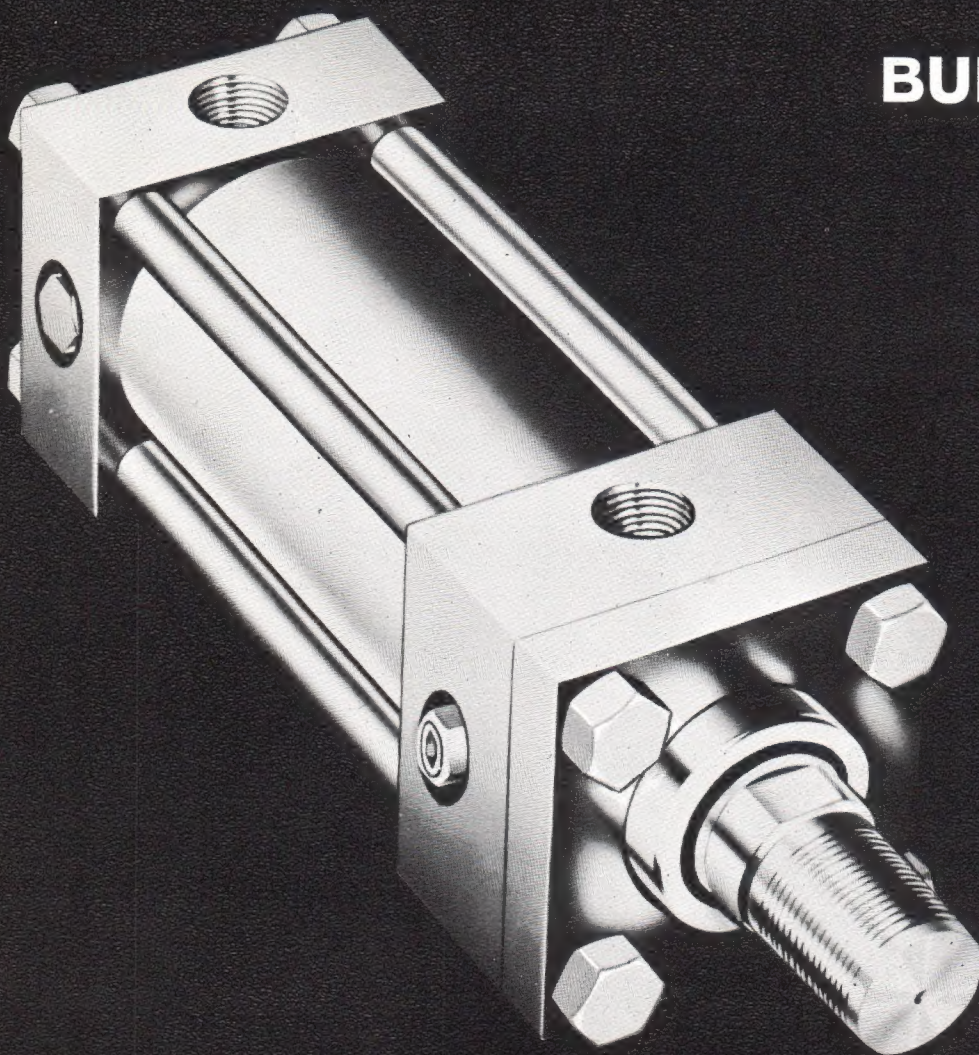


# BULLETIN HA-100

SERIES "HA"

250 PSI

1½" TO 12" BORE



# **milwaukee**

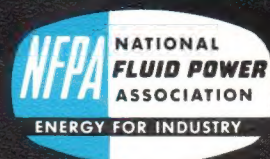
HEAVY DUTY

## **FOUNDRY TYPE**

### *AIR Cylinders*

**milwaukee**  
*Cylinder*  
corporation

5877 SOUTH PENNSYLVANIA AVE. • CUDAHY, WISCONSIN 53110  
PHONE (414) 769-9700 • TWX-910-262-3197



Member of the National  
Fluid Power Association



# **milwaukee**

**HEAVY DUTY**

**SERIES "HA"**

## **FOUNDRY TYPE**

# AIR *Cylinders*



*Member of the National Fluid Power Association*

## **Performance Tested and Conforms to NFPA Standards**

"MILWAUKEE" Series "HA" Foundry Type Air Cylinders are built to perform on the toughest of applications.

Incorporating a variety of MILWAUKEE "Exclusive" advanced features, proven through the years, these cylinders

will provide a long maintenance free service life.

Advanced engineering combined with quality materials and expert workmanship, contribute to the making of a rugged top quality cylinder especially for foundry usage.

## **DESIGN FEATURES**

**ACTION** Milwaukee cylinders are made with either single or double action.

- (1). Double acting cylinders—air power drives the piston in both directions.
- (2). Single acting cylinders—air power drives the piston in one direction only.

Single acting spring return cylinders normally have a spring inside the cylinder to return the piston to its original starting position. Such springs are designed to return only the weight of the piston and the fluid. Where heavy loads are to be lifted or moved on the return stroke, it is suggested that you order a single action non-spring return cylinder . . . and install an external spring suitable to the load to be returned . . . or specify a double acting cylinder.

**PISTON RODS** Milwaukee furnishes style 1 piston rods unless customer specifies another style. Styles 2-3-4-5-6 are available without additional charge. Special rod ends are available at extra charge and must be specified.

Two flats are standard on piston rods. 4 or 6 flats can be furnished at slight additional charge. Specify location of flats.

**PORTS** Inlet ports on Milwaukee cylinders can be arranged in any one of four 90° positions in relation to the cylinder mounting. Ports will be supplied in position No. 1 unless otherwise specified.

**SEALS** Standard cylinders incorporate Buna-N and Fabric "V" ring rod packing, poly-urethane piston U-cups and double lip rod wiper. These seals are suitable for use at temperature ranges of -20°F. to +200°F. and with petroleum base lubricating fluids.

Seals are available for extreme temperature ranges and for fire-resistant lubricating fluids. Consult the factory on these requirements.

**PISTON** Piston is of one piece construction and is concentric with the centerline of the piston rod. The piston to barrel contact is through a low friction, replaceable non-scoring wear ring. Seals are poly-urethane single lip, U-cup type and can be replaced without removing the piston from the rod. The outer piston lands are of a reduced diameter to permit air flow to seals for instant low pressure flaring or sealing. The piston faces are essentially flat, reducing unswept volume in cushioned models for higher pressure build-up.

**CUSHIONS** Cushions are available for both ends of cylinder. Mounting dimensions are the same for non-cushioned or cushioned cylinders. Cushions are designed for a controlled rate of deceleration and incorporate a built-in check ball for fast acceleration with full area available on return stroke. Cushion bushings are floating on "O" rings to compensate for minor misalignments in operation. Extra long cushions can be provided on request.

**NAMEPLATE** The nameplate is normally located on the side of the cylinder head at blind end . . . to be readable when the piston rod is mounted in the down position. It details: serial number (your key to ordering parts), model, bore, stroke, operating medium and maximum operating pressures. Specify, if special location is desired.



#### ROD BEARING AND SEALS

Spring loaded multiple lip vee rings with supporting bronze bushing is standard in Milwaukee Series "HA" cylinders. As an optional design, the directly interchangeable bronze bushing incorporating single lip Black Vee and double lip rod wiper is available. Metallic rod scrapers can also be supplied on request.

This unique versatility of seals can be accomplished with a simple bushing change and makes available a selection of seals to meet all types of service conditions.

#### LARGE UNRESTRICTED PORTS

Large cylinder ports are provided and can be rotated to any 90° position in relation to each other and the mounting. Straight thread ports can also be provided to receive a metal ring seal or "O" ring seal fitting.

#### BAR STOCK STEEL END CAPS AND MOUNTINGS

End caps and mountings are of bar stock steel, precision machined for accurate mounting to matching beds

#### END CAP SEALS

The barrel is sealed to the end caps by confined "O" ring packings and back up washers resulting in superior sealing characteristics at the higher operating pressures.

#### CYLINDER BARRELS

Cold drawn steel tubing, honed to 10 micro-inch finish, hard chrome plated, provides superior sealing power, minimum friction and long seal life.

#### TIE RODS AND TIE ROD NUTS

The tie rods are constructed from a high quality medium carbon steel. Threads are accurately machined for rigid engagement of the self-locking nuts.

#### CUSHION BUSHING

These high grade alloy cushion plungers are precision machined and specially tapered to provide smooth deceleration of the piston at the end of the stroke.

#### PISTON RODS

Medium carbon steel, induction hardened to RC 54, ground and polished to low micro finish and hard chrome plated to resist scoring.

#### REMOVABLE BUSHING AND RETAINER PLATE

The retainer plate and rod bushing is externally removable without disassembling cylinder, standard on most models. Four "Nylock" cap screws securely hold and lock the retainer plate in place. The removal of rod bushing and seals can be performed using available shop tools.

#### CUSHION NEEDLE ADJUSTMENT AND BALL CHECK

Cushion needle adjustment valve and cushion-check ball retainer screw specially designed to provide full cushion adjustment and sealed with Teflon ring seal to prevent leakage. The needle valve and ball check retainer are interchangeable.

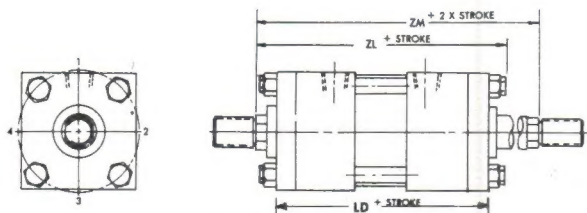
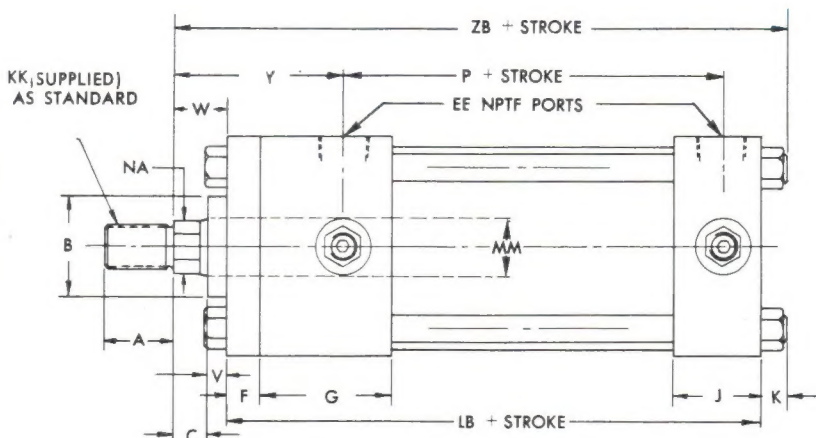
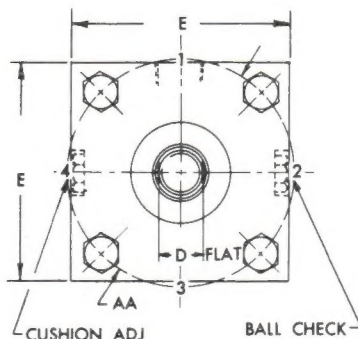
#### PISTON

Precision machined from medium carbon steel and threaded on to the rod. Piston is locked to the piston rod with a self-locking set screw.

**'milwaukee' Cylinders Guaranteed Against Defects in Materials and Workmanship**

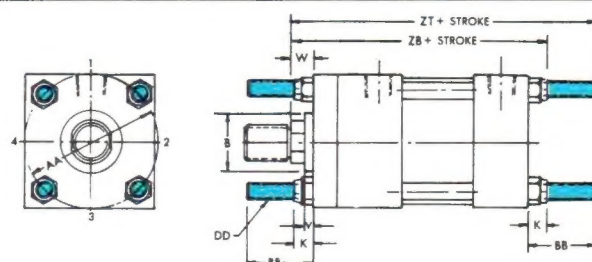


## CONFORMS TO NFPA STANDARDS

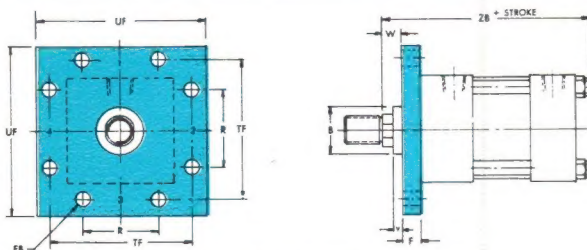


### DOUBLE ROD END CYLINDERS

Available in all models except HA-61. Use above dimensions for other models adding desired mounts. To specify Double End Rods add suffix letter "D" to code NUMBER.  
NFPA MX-D

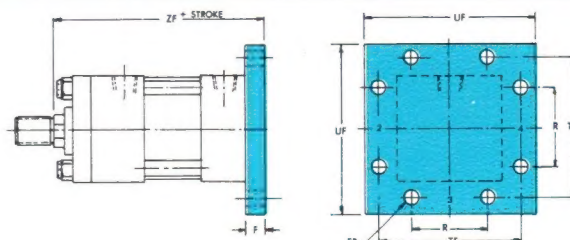


NFPA MX1 Model HA-10 — Plain, Tie Rods extended both ends.  
NFPA MX Model HA-11 — Plain, no Tie Rod extension.  
NFPA MX3 Model HA-12 — Plain, Tie Rods extended Head End.  
NFPA MX2 Model HA-13 — Plain, Tie Rods extended Cap End.



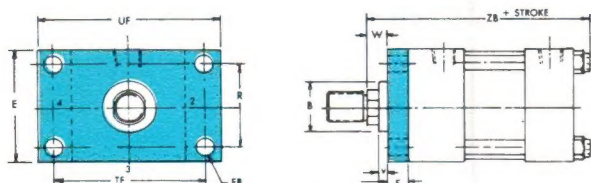
### MODEL HA-21 — Square Flange on Head End NFPA MF5

(Recommended for maximum pressure and severe service)



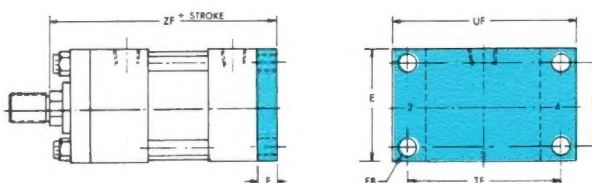
### MODEL HA-22 — Square Flange on Cap End NFPA MF6

(Recommended for maximum pressure and severe service)



### MODEL HA-31 — Rectangular Flange on Head End

NOTE: See Page 7 — Table No. 4 for Pressure Ratings on Flange.  
NFPA MF1



### MODEL HA-32 — Rectangular Flange on Cap End

NOTE: See Page 7 — Table No. 4 for Pressure Ratings on Flange.  
NFPA MF2

## HOW TO ORDER

State: 1. Quantity cylinder desired. 2. Model number. 3. Rod diameter (specify if material is special). 4. Action if single acting cylinders, specify if air enters head or cap end. 5. PSI cylinder reading, operating medium. PSI operation

you require. 6. Stroke. 7. Bore. 8. Cushions required. 9. Piston rod end style. 10. Port location if other than standard is desired. 11. Operating temperature, if above 250° F. or below -30° F.



# AIR PRESSURE AND FLOW DATA

**TABLE 5 — THRUST FORCE — POUNDS**

Bore Size	Piston Area Sq. In.	CYLINDER THRUST FORCE IN POUNDS FOR VARIOUS LINE PRESSURES						Vol. Per Inch of Stroke	
		80	100	125	150	200	250	Pressure Air Cu. Ft.	Free Air 80 PSI Cu. Ft.
1½	1.77	141	177	221	265	354	442	.00102	.00657
2	3.14	251	314	393	471	628	785	.00182	.01185
2½	4.91	393	491	614	737	982	1228	.00284	.01829
3¼	8.30	664	830	1038	1245	1660	2075	.00480	.03091
4	12.57	1006	1257	1571	1886	2514	3143	.00727	.04682
5	19.64	1571	1964	2455	2946	3928	4910	.01137	.07324
6	28.27	2262	2827	3534	4241	5654	7068	.01636	.10538
7	38.49	3079	3849	4811	5774	7698	9623	.0222	.15312
8	50.27	4022	5027	6284	7541	10,054	12,568	.02909	.18740
10	78.54	6283	7854	9818	11,781	15,708	19,635	.04545	.29279
12	113.1	9048	11,310	14,138	16,965	22,620	28,275	.06545	.42160

**NOTE:**

To determine cylinder pull stroke force or displacement, deduct force or displacement corresponding to rod size in Table 6 from force or displacement corresponding to bore size shown in Table 5.

**TABLE 6 — DEDUCTIONS FOR PULL STROKE FORCE — POUNDS**

Rod Dia.	Rod Area Sq. In.	ROD DIAMETER FORCE IN POUNDS FOR VARIOUS LINE PRESSURES						Vol. Per Inch of Stroke	
		80	100	125	150	200	250	Pressure Air Cu. Ft.	Free Air 80 PSI Cu. Ft.
5/8	.307	25	31	38	46	61	77	.00018	.00116
1	.785	63	79	98	118	157	196	.00045	.00290
1⅝	1.485	119	149	186	223	297	371	.00086	.00554
1¾	2.405	192	241	300	360	481	601	.00139	.00895
2	3.142	251	314	393	471	628	786	.00182	.01172
2½	4.909	393	491	614	736	982	1227	.00284	.01829
3	7.069	566	707	884	1060	1414	1767	.00409	.02635
3½	9.621	770	962	1202	1443	1924	2405	.00557	.03588
4	12.566	1006	1257	1570	1885	2513	3142	.00727	.04683
4½	15.904	1272	1590	1988	2386	3181	3976	.00920	.05926
5	19.635	1571	1964	2454	2945	3927	4909	.01137	.07324
5½	23.758	1901	2376	2970	3564	4752	5940	.01375	.08857

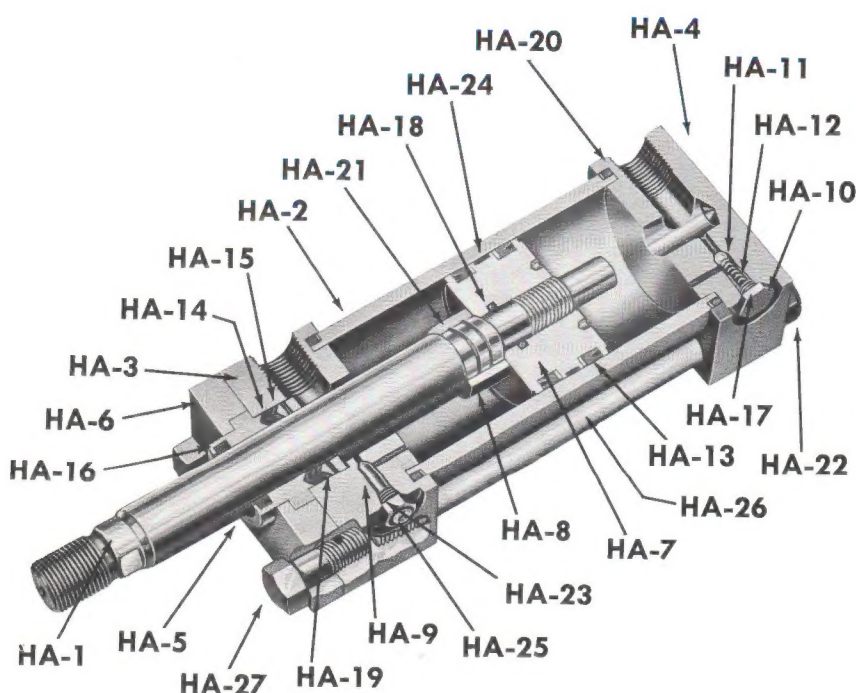
**PIPING:**

All pipes should be free from dirt, scale, rust, and threads deburred. Seamless steel tubing makes an installation superior to piping as it is cleaner and leak-proof.

## Parts List

## milwaukee SERIES "HA"

## Heavy Duty Foundry Type Air Cylinders



- |       |  |       |  |
|-------|--|-------|--|
| HA-1  | PISTON ROD                                     | HA-16 | ROD WIPER                                  |
| HA-2  | CYLINDER BARREL                                | HA-17 | "O" RING SEAL FOR BALL CHECK RETAINER      |
| HA-3  | HEAD END CAP                                   | HA-18 | "O" RING SEAL FOR PISTON                   |
| HA-4  | CAP END CAP                                    | HA-19 | WAVE SPRING                                |
| HA-5  | ROD BUSHING                                    | HA-20 | CYLINDER BARREL "O" RING AND BACKUP WASHER |
| HA-6  | RETAINER PLATE                                 | HA-21 | "O" RINGS FOR FLOATING CUSHION             |
| HA-7  | PISTON   | HA-22 | TIE ROD FLEX LOC NUT                       |
| HA-8  | CUSHION PLUNGER                                | HA-23 | TEFLON RING SEAL FOR CUSHION ADJ. NEEDLE   |
| HA-9  | CUSHION ADJ. NEEDLE                            | HA-24 | PISTON WEAR RING                           |
| HA-10 | BALL CHECK RETAINER                            | HA-25 | JAM NUT FOR CUSHION ADJ. NEEDLE            |
| HA-11 | BALL CHECK                                     | HA-26 | TIE ROD                                    |
| HA-12 | BALL CHECK SPRING                              | HA-27 | NYLOCK CAP SCREW                           |
| HA-13 | BLOCK VEE PACKING AND BACKUP WASHER FOR PISTON |       |  |
| HA-14 | ROD VEE RING SET                               |       |  |
| HA-15 | REAR BEARING RING                              |       |  |

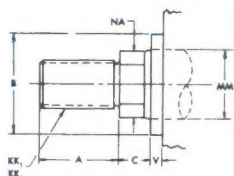


# TABLE 1

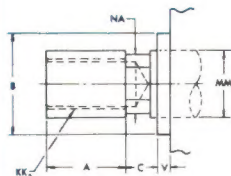
## GENERAL ROD DIMENSIONS

Rod MM	KK <sub>1</sub>	KK <sub>2-5</sub>	CC	A	B .001 .003	C	D	NA
5/8	1/2-20	3/16-20	5/8-18	3/4	1 1/8	3/8	1/2	1 1/32
1	7/8-14	3/4-16	1-14	1 1/8	1 1/2	1/2	3/8	5/32
1 1/8	1 1/4-12	1-14	1 3/8-12	1 5/8	2	5/8	1 1/8	1 1/32
1 3/4	1 1/2-12	1 1/4-12	1 3/4-12	2	2 3/8	3/4	1 1/2	1 1/64
2	1 3/4-12	1 1/2-12	2-12	2 1/4	2 5/8	7/8	1 1/16	1 1/64
2 1/2	2 1/4-12	1 3/4-12	2 1/2-12	3	3 3/8	1	2 1/16	2 1/64
3	2 3/4-12	2 1/4-12	3-12	3 1/2	3 3/4	1	2 5/8	2 1/16
3 1/2	3 1/4-12	2 1/2-12	3 1/2-12	3 3/2	4 1/4	1	3	3 1/16
4	3 3/4-12	3-12	4-12	4	4 3/4	1	3 3/8	3 1/16
4 1/2	4 1/4-12	3 3/4-12	4 1/2-12	4 1/2	5 1/4	1	3 7/8	4 1/64
5	4 3/4-12	3 1/2-12	5-12	5	5 3/4	1	4 1/4	4 5/64
5 1/2	5 1/4-12	4-12	5 1/2-12	5 1/2	6 1/4	1	4 5/8	5 3/64

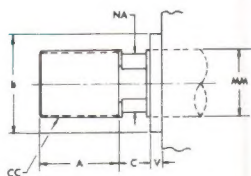
## PISTON ROD END STYLES



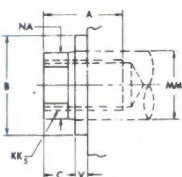
ROD END NO. 1 and 2



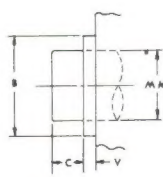
ROD END NO. 3



ROD END NO. 4



ROD END NO. 5



ROD END NO. 6

## VARYING LENGTH DIMENSIONS

Bore Dia.	Rod MM	V	W	Y	ZB	XC	XE	XJ	XG	XS	XT	ZC	ZE	ZF	ZL	ZM	ZT
1 1/2	5/8	1/4	5/8	2	6 1/8	6 3/8	6 1/2	4 7/8	2	1 3/8	2	6 7/8	6 7/8	6	6 3/4	6 7/8	7
	*†† 1	1 1/2	Y	2 3/8	6 1/2	6 3/4	6 7/8	5 1/4	2 3/8	1 3/4	2 3/8	7 1/4	7 1/4	6 3/8	7 1/8	7 5/8	7 3/8
2	1	1/4	3/4	2 3/8	6 5/8	7 1/4	6 1 3/8	5 1/4	2 3/8	1 7/8	2 3/8	8	7 7/8	6 5/8	7 1/2	7 5/8	7 1 1/8
	*†† 1 1/2	3/8	1	2 5/8	6 7/8	7 1/2	7 1 3/8	5 1/2	2 3/8	2 1/8	2 3/8	8 1/4	7 1 1/8	6 7/8	7 3/4	8 1/8	8 1 1/8
2 1/2	1	1/4	3/4	2 3/8	6 3/4	7 3/8	7 1 3/8	5 3/8	2 3/8	2 1 3/8	2 3/8	8 1/8	7 7/8	6 3/4	7 5/8	7 3/4	7 1 3/8
	*1 3/8	1	2 5/8	7	7 5/8	7 3 3/8	5 5/8	2 5/8	2 1 3/8	2 5/8	8 3/8	7 1 1/8	7	7 7/8	8 1/4	8 3 3/8	
	*†† 1 3/4	1 1/2	1 1/4	2 7/8	7 1/4	7 7/8	7 3 3/8	5 7/8	2 7/8	2 5 3/8	2 7/8	8 5/8	8 1 3/8	7 1/4	8 1/8	8 3/4	8 7 3/8
3 3/4	1 3/8	1/2	7/8	2 1 3/8	7 7/8	8 5/8	8 1/4	6 1/4	2 3/4	2 1 3/8	2 3/4	9 5/8	8 7/8	7 7/8	8 7/8	9	9 7 3/8
	1 3/4	3/8	1	2 1 3/8	8 1/8	8 7/8	8 1/2	6 1/2	3	2 1 3/8	3	9 7/8	9 1/8	8 1/8	9 1/8	9 3/4	9 1 1/8
	*†2	3/8	1 1/4	3 3/8	8 1/4	9	8 5/8	6 5/8	3 1/8	2 1 3/8	3 1/8	10	9 1/4	8 1/4	9 1/4	9 3/4	9 1 1/8
4	1 3/4	1/4	1	2 1 3/8	8 3/8	9 3/4	8 3/4	6 3/4	3	2 3/4	3	11 1/8	9 3/8	8 1/2	9 1/2	9 3/4	9 1 3/8
	*2	1/4	1 1/8	3 1 3/8	8 1/2	9 7/8	8 7/8	6 7/8	3 1/8	2 7/8	3 1/8	11 1/4	9 1/2	8 5/8	9 5/8	10	10 1 3/8
	*2 1/2	3/8	1 3/8	3 1 3/8	8 3/4	10 1/8	9 1/8	7 1/8	3 3/8	3 1/8	3 3/8	11 1/2	9 3/4	8 7/8	9 7/8	10 1/2	10 1 3/8
5	2	1/8	3/8	3 1 3/8	9 1/4	10 1/2	9 3/4	7 3/8	3 1/8	3 1/8	3 1/8	12 1/8	10 1/2	9 1/8	10 3/8	10 1/2	11 1 3/8
	2 1/2	3/8	1 3/8	3 1 3/8	9 1/2	10 3/4	10	7 5/8	3 3/8	3 1/8	3 3/8	12 3/8	10 3/4	9 3/8	10 5/8	11	11 1 3/8
	3	3/8	1 3/8	3 1 3/8	9 1/2	10 3/4	10	7 5/8	3 3/8	3 1/8	3 3/8	12 3/8	10 3/4	9 3/8	10 5/8	11	11 1 3/8
	*3 1/2	3/8	1 3/8	3 1 3/8	9 1/2	10 3/4	10	7 5/8	3 3/8	3 1/8	3 3/8	12 3/8	10 3/4	9 3/8	10 5/8	11	11 1 3/8
6	2 1/2	1/4	1 1/4														
	3	1/4	1 1/4														
	3 1/2	1/4	1 1/4														
	*4	1/4	1 1/4														
7	3	1/4	1 1/4														
	3 1/2	1/4	1 1/4														
	4	1/4	1 1/4	3 3/4	12	13 3/4	12 7/8	9 3/8	3 5/8	3 3/8	3 1 1/8	16 1/8	13 1/2	11 3/4	13	13	14 7/8
	*4 1/2	1/4	1 1/4														
8	*5	1/4	1 1/4														
	3 1/2	1/4	1 1/4														
	4	1/4	1 1/4														
	4 1/2	1/4	1 1/4	3 7/8	13 1/4	15	13 3/4	10 1/4	3 3/4	3 5/8	3 1 3/8	17 3/4	14 7/8	12 3/4	14 1/4	14	16 1/4
10	5	1/2	1 1/2	5 7/8	16 1 1/8	19 1 1/8	—	13 1/4	4 3/4	4 5/8	5	22 5/8	—	16 3/4	18 3/8	18	21 1 1/8
	5 1/2	1/2	1 1/2	5 7/8	16 1 1/8	19 1 1/8	—	13 1/2	5	4 1 1/8	5 1/4	22 1 1/8	—	17	19 5/8	18 1/2	21 1 1/8
12	5 1/2	1/4	1 1/4	5 1 1/8	19 9/16	22 3/16	—	15 1/2	5 3/8	5 7/8	5 3/4	26 3/8	—	19 5/8	21 1/4	20 7/8	24 1 1/8

### NOTES:

\* Model 41 not available in these sizes.

† Available with fixed-nonadjustable cushions on rod end, adj. cush. blind end.

‡ Standard rod eye or rod clevis will interfere with foot lugs on Model 43. Use additional rod extension.

▲ For dbl. rod end cyls. 1 1/2" to 5" bore add 1/4" to dim.

**TRUNNION MTGS.:** Trunnion pins are designed for shear. Mount and clamp in sturdy pillow blocks to prevent bending loads. Pins are hard chrome plated. Can be supplied with removable trunnion pins.

**FOOT MTGS.:** Mounting holes are sized 1/16" dia. over bolt size. For best results drill and pin in place after installation.

**PORTS:** Standard cylinders have NPTF ports. S.A.E. "O" ring ports or manifold ports are available.

**CUSHIONS:** Standard cushion length is 1 1/8". Longer cushions are available but increases cylinder length.

## GENERAL

Bore	E	F	G	J	K	P	R	AA	EE	LB	LD	TL	UT	TD	BT	TK	TP	UI	UH	FBS	TF	UF	BB	DD
1 1/2	2 1/2	3/8	1 3/4	1 1/2	1/2	2 7/8	1.63	2.3	1/2	5	5 5/8	1	4 1/2	1	3/4	1 1/2	4	6	2 1/2	1 1/8	3 7/8	4 1/4	1 3/8	3/8-24
2	3	5/8	1 3/4	1 1/2	5/8	2 7/8	2.05	2.9	1/2	5 1/4	6 1/8	1 3/8	5 3/4	1 3/8	1	2	5	7 3/4	3 3/8	1 1/8	4 1/8	5 1/8	1 1/2	1/2-20
2 1/2	3 1/2	5/8	1 3/4	1 1/2	5/8	3	2.55	3.6	1/2	5 3/8	6 1/4	1 3/8	6 1/4	1 3/8	1	2	5 1/2	8 1/4	4 1/8	1 1/8	4 5/8	5 5/8	1 1/2	1/2-20
3 1/4	4 1/2	3/4	2	1 3/4	3/4	3 5/8	3.25	4.6	3/4	6 1/4	7 1/4	1 3/4	8 1/4	1 3/4	1 1/4	2 1/2	7	10 1/2	5	1 1/8	5 3/8	7 1/8	2 1/8	5/8-18
4	5	7/8	2	1 3/4	3/4	3 3/8	3.82	5.4	3/4	6 3/8	7 3/4	1 3/4	8 1/2	1 3/4	1 1/4	2 1/2	7 1/2	11	6 1/2	1 1/8	6 3/8	7 7/8	2 1/8	5/8-18
5	6 1/2	7/8	2	1 3/4	1	4 3/8	4.95	7.0	3/4	7 1/8	8 1/4	1 3/4	10	1 3/4	1 1/4	3	9	12 1/2	7 1/2	1 1/8	8 1/8	9 3/4	3 1/8	7/8-14
6	7 1/2	1	2 1/4	2 1/4	1 1/8	5 1/4	5.73	8.1	1	8 3/8	9 3/8	2	11 1/2	2	1 1/2	3 1/2	10 1/2	14 1/2	8 3/4	1 1/8	9 1/8	11 1/4	3 3/8	1-14
7	8 1/2	1	2 3/4	2 3/4	1 1/4	5 1/2	6.58	9.3	1 1/4	9 1/2	10 1/2	2 1/2	13 1/2	2 1/2	1 3/4	4	12	17	10	1 1/8	10 5/8	12 5/8	4 1/8	1 1/8-12
8	9 1/2	1	3	3	1 1/2	6 3/4	7.50	10.6	1 1/2	10 1/2	11 1/2	3	15 1/2	3	1 3/4	4 1/2	13	19	11	1 1/8	11 1/2	14	4 1/2	1 1/4-12
10	12 5/8	1 1/8	3 1/2	3 1/2	1 5/8	8 5/8	9.62	13.62	2	13 1/2	15 1/2	3 1/2	19 5/8	3 1/2	2 1/4	5	17 1/8	24 1/8	15 1/4	1 1/2	15 3/8	19	6	1 3/4-12
12	14 3/8	1 1/2	4 1/8	4 1/8	1 7/8	10 1/4	11.45	16.25	2 1/2	16 1/8	18 3/8	4	22 7/8	4	3	5 1/2	20 7/8	28 7/8	19 1/4	2 1/8	18 1/2	22	7	2-12

## HA 61

## HA 41

## HA 42-51

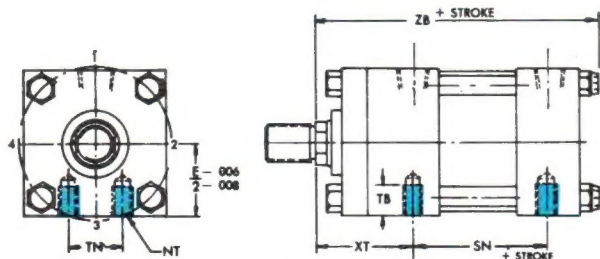
## HA 43

Bore	L	M	CB	CD	CW	MR	LR	NT	SN <sup>▲</sup>	TB	TN	SB <sup>§</sup>	SS <sup>▲</sup>	ST	SU	SW	TS	US	EB <sup>§</sup>	EL	EO	ET	SE <sup>▲</sup>
1 1/2	3/4	1/2	3/4	1/2	1/2	2 1/32	5/8	3/8-16	2 7/8	1 1/8	3/4	1 1/8	3 7/8	1/2	1 1/8	3/8	3 1/4	4	1 1/8	7/8	3/8	3/4	6 3/4
2	1 1/4	3/4	1 1/4	3/4	5/8	1 1/8	1 1/8	1 1/2-13	2 7/8	5/8	1 1/8	1 1/8	3 5/8	3/4	1 1/4	1/2	4	5	1 1/8	1 1/8	1/2	7/8	7 1/8
2 1/2	1 1/4	3/4	1 1/4	3/4	5/8	1 1/8	1 1/8	5/8-11	3	7/8	1 1/8	1 1/8	3 3/8	1	1 1/8	1 1/8	4 7/8	6 1/4	1 1/8	1 1/8	1/2	7/8	7 1/4
3 1/4	1 1/2	1	1 1/2	1	3/4	1	1 1/4	3/4-10	3 1/2	1	1 1/2	1 1/2	4 1/8	1	1 1/8	1 1/8	5 7/8	7 1/4	1 1/8	1 1/8	5/8	1 1/8	8 1/2
4	2 1/8	1 3/8	2	1 3/8	1	1 3/8	1 7/8	1-8	3 3/4	1 3/8	2 1/8	1 1/8	4	1 1/4	2	7/8	6 3/4	8 1/2	1 1/8	1 1/8	5/8	1 1/8	8 3/8
5	2 1/4	1 5/8	2 1/2	1 3/4	1 1/4	1 5/8	2	1-8	4 1/4	1 1/2	2 1/8	1 1/8	4 1/2	1 1/4	2	7/8	8 1/4	10	1 1/8	1 1/8	3/4	1 1/2	10 1/8
6	2 1/2	2	2 1/2	2	1 1/4	2	2 1/8	1 1/4-7	5 1/8	1 3/4	3 1/8	1 1/8	5 1/8	1 1/2	2 1/2	1 1/8	9 3/4	12	1 1/8	1 1/8	1 1/4	1 5/8	11 3/4
7	3	2 3/8	3	2 1/2	1 1/2	2 3/8	2 5/8	1 1/2-6	5 7/8	1 7/8	3 3/4	1 1/8	5 3/4	1 3/4	2 7/8	1 3/8	11 1/4	14	1 1/8	1 1/8	1 1/4	1 3/4	13 1/8
8	3 1/4	2 3/4	3	3	1 1/2	2 3/4	2 7/8	1 1/2-6	6 5/8	1 7/8	4 1/4	1 1/8	6 3/4	1 3/4	2 7/8	1 3/8	12 1/4	15	1 1/8	2	1 1/8	2	14 1/2
10	4	3 1/2	4	3 1/2	2	3 1/2	3 1/2	1 1/2-6	8 1/2	2 1/4	5 3/4	1 1/8	8 7/8	2 1/4	3 1/2	1 5/8	15 7/8	19 1/8	—	—	—	—	—
12	4 1/2	4	4 1/2	4	2 1/4	4	4	1 1/2-6	10 1/8	2 1/4	7 1/4	1 1/8	10 1/2	3	4 1/4	2	18 7/8	22 7/8	—	—	—	—	—

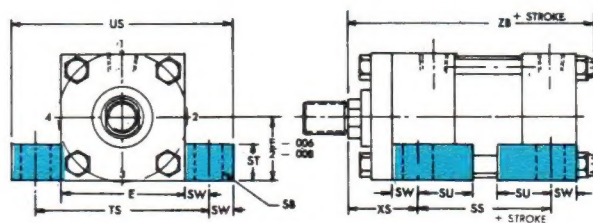
§ Use Mounting Bolts 1/8" Smaller.



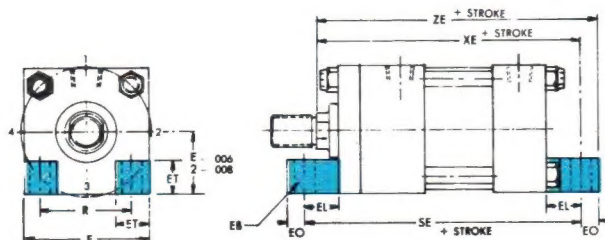
# FOUNDRY AIR *Cylinders*



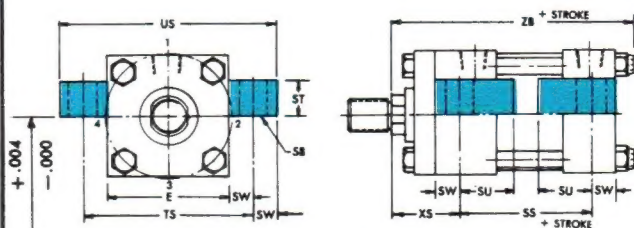
**MODEL HA41 — Flush Mount tapped holes in Caps  
NFPA MS4**



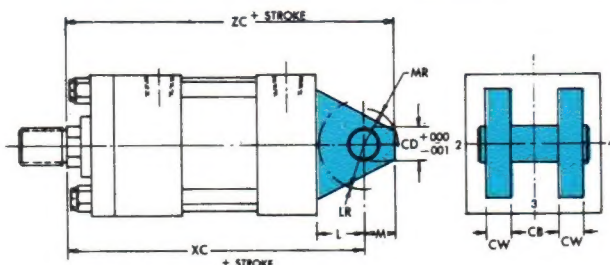
**MODEL HA42 — Side Lugs  
NFPA MS2  
(Modification for manifold porting available)**



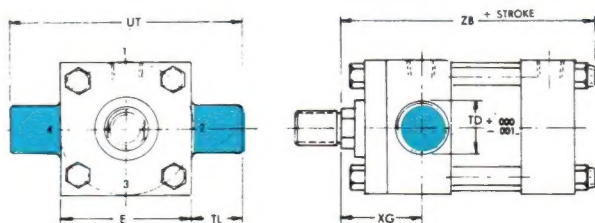
**MODEL HA43 — Foot Mounted  
NFPA MS7**



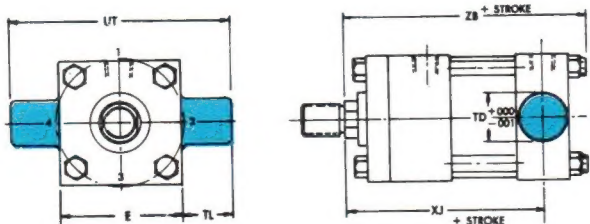
**MODEL HA51 — Centerline Lugs  
NFPA MS3  
Tol. Above Centerline**



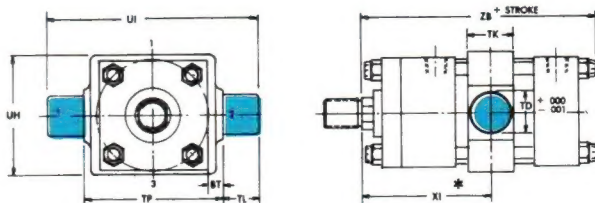
**MODEL HA61 — Clevis Mount.  
NFPA MP1**



**MODEL HA71 — Trunnion Head End  
NFPA MT1**



**MODEL HA72 — Trunnion Cap End  
NFPA MT2**



**MODEL HA73 — Trunnion Between Head and Cap End  
NFPA MT4**

\* Customer to Specify X1 Dimension.

SELF-LOCKING  
SOC. HEAD  
CAP SCREW

TRUNNION PINS  
HARD CHROME PLATED

REMOVABLE TRUNNIONS FOR  
"HA" SERIES CYLINDERS  
NOT AVAILABLE ON LARGEST  
OVERSIZE ROD MODEL 71

Notes: Trunnion dimensions same as 71, 72, and 73.  
Add 10% to base price.

Customer to specify Removable Trunnions



## SERIES "HA"

## engineering data

### DETERMINATION OF ROD SIZE AND STOP TUBE APPLICATIONS

#### ROD SIZE SELECTION

"Milwaukee" Air Cylinders incorporate a high strength, surface hardened rod. Standard rod sizes are generally suitable for most applications, however, on long stroke or high thrust applications, the selection of minimum rod size should be checked using the following steps:

1. Knowing bore size, stroke, and push thrust (refer to Table No. 6, page 8), determine the overall length between mounting points, Table 1, page 5. Equate determined overall length to "L".
2. Select from Table 2, page 7, the type mounting being used and determine the equivalent length dimension "K".
3. Refer to Table 3 and using thrust load and developed "K" dimension, select rod size.
4. If oversize rod is required, re-check overall length dimension as determined in step No. 1. There will be a slight change which generally will not affect the "Size Determination" calculations, but must be considered in the cylinder installation.

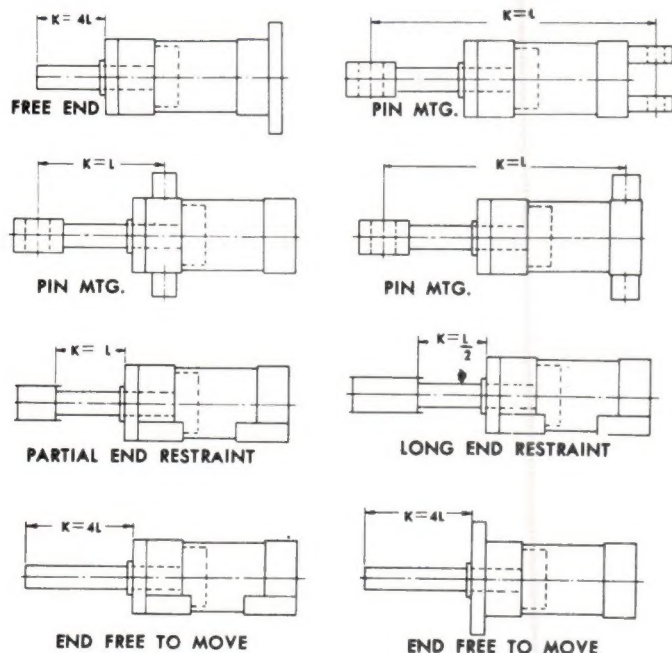
#### STOP TUBE APPLICATIONS

Stop tubes are used to develop a maximum distance between the two bearing members, the piston and rod bushing, thus enabling them to resist moments developed due to sag in long stroke cylinders and to known side loads on the rod.

Cylinders having a calculated "K" dimension in excess of 40 inches, require stop tubes. For each 10 inch increment or fraction thereof in excess of 40 inches, one inch of stop tube is recommended. The overall length of the cylinder will be increased in accordance with the number of added inches of stop tube.

When mounting long stroke cylinders care should be exercised in checking alignment over entire stroke length. The use of external guides or swivel bushing attachments is recommended to reduce side loading conditions and prolong usable life of the cylinder.

**STROKE TO MOUNTING RELATIONSHIP  
TABLE 2 — ALL RODS IN EXTENDED POSITION**



**TABLE 3 — VALUE OF "K" IN INCHES**

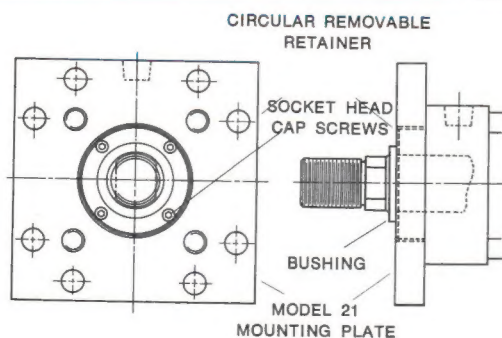
THRUST FORCE In. Lbs.	PISTON ROD DIAMETER												
	3/8"	1"	1 1/8"	1 3/4"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	5 1/2"	
400	35	84	134										
700	30	68	119										
1,000	26	60	105	156	190								
1,400	24	54	93	144	175	244	308						
1,800	23	48	84	127	160	230	294	366					
2,400	18	45	75	114	145	214	281	347					
3,200	16	40	68	103	131	196	262	329	398				
4,000	12	38	63	93	119	174	240	310	373	446			
5,000	9	36	60	87	112	163	225	289	359	426			
6,000		30	56	82	102	152	209	274	342	411	476		
8,000		25	51	76	93	136	186	244	310	375	448		
10,000		21	45	70	89	125	172	221	279	349	412		
12,000		17	41	64	85	117	155	210	270	326	388	455	
16,000			35	57	75	110	141	188	233	291	350	421	
20,000			28	52	66	103	136	173	218	270	325	385	
30,000				39	56	87	120	156	190	232	285	330	

**TABLE 4  
NUT TORQUE SPECIFICATIONS**

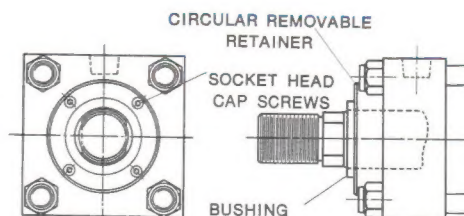
Cylinder Bore		1 1/2	2-2 1/2	3 3/4-4	5	6	7	8	10	12
TORQUE FT. LBS.	MIN.	6	15	30	80	120	180	260	600	1000
	MAX.	10	20	35	100	140	200	300	800	1200

NOTE: Prevent Tie Rod from twisting when tightening by use of Vise Grips or Locking Clamp. Torque based on lubricated threads.

#### CIRCULAR RETAINERS ON "HA" CYLINDERS



Model "HA" Cylinders in 7" through 12" bores, all rod sizes, all mountings (except HA-31) have a circular retainer holding the rod packing and bushing in place. Circular retainer is also used on 3 1/4" to 6" Bore, Models HA-22, 32, 43, 61 and 73, with standard rod and first oversize rod. All other models and bore sizes not mentioned use square removable retainer.





# "MILWAUKEE" ACCESSORIES

## SERIES HA AIR CYLINDER

### ROD CLEVIS

Part No.	Bore Size	Thread Size KK	A	CB	CD	CE	CW	CR	List Price
C101	1 1/2	7/8-20	3/4	3/4	1/2	1 1/2	1/2	1/2	4.00
C102	2-2 1/2	3/4-16	1 1/8	1 1/4	3/4	2 3/8	5/8	3/4	6.25
C103	3 1/4	1-14	1 5/8	1 1/2	1	3 1/8	3/4	1	9.40
C104	4	1 1/4-12	2	2	1 3/8	4 1/8	1	1 3/8	13.90
C105	5	1 1/2-12	2 1/4	2 1/2	1 3/4	4 1/2	1 1/4	1 5/8	17.90
C106	6	1 7/8-12	3	2 1/2	2	5 1/2	1 1/4	2	24.30
C107	7	2 1/4-12	3 1/2	3	2 1/2	6 1/2	1 1/2	2 3/8	51.05
C108	8	2 1/2-12	3 1/2	3	3	6 3/4	1 1/2	2 3/4	57.75

### ROD EYE

Part No.	Bore Size	Thread Size KK	A	CA	CB	CD	CR	ER	List Price
C301	1 1/2	7/8-20	3/4	1 1/2	3/4	1/2	1/2	7/16	4.00
C302	2-2 1/2	3/4-16	1 1/8	2 1/4	1 1/4	3/4	3/4	1 1/4	5.50
C303	3 1/4	1-14	1 5/8	2 1/2	1 1/2	1	1	1 1/8	9.40
C304	4	1 1/4-12	2	3 1/4	2	1 3/8	1 3/8	1 7/8	13.30
C305	5	1 1/2-12	2 1/4	4	2 1/2	1 3/4	1 3/4	1 7/8	18.70
C306	6	1 7/8-12	3	5	2 1/2	2	2	2	24.25
C307	7	2 1/4-12	3 1/2	5 1/2	3	2 1/2	2 1/2	2 1/2	41.70
C308	8	2 1/2-12	3 1/2	6 1/8	3	3	2 3/4	2 3/4	50.80

### CLEVIS BRACKET

Part No.	Bore Size	AA	CB	CD	CW	DD	E	F	FL	LR	MR	List Price
B101	1 1/2	2.3	3/4	1/2	1/2	3/8-24	2 1/2	3/8	1 1/8	1 1/16	1/2	12.15
B122	2	2.9	1 1/4	3/4	5/8	1/2-20	3	5/8	1 7/8	1 1/16	3/4	16.35
B102	2 1/2	3.6	1 1/4	3/4	5/8	1/2-20	3 1/2	5/8	1 7/8	1 1/16	3/4	18.95
B103	3 1/4	4.6	1 1/2	1	3/4	5/8-18	4 1/2	3/4	2 1/4	1 3/8	1	23.25
B104	4	5.4	2	1 3/8	1	5/8-18	5	7/8	3	1 7/8	1 3/8	27.45
B105	5	7.0	2 1/2	1 3/4	1 1/4	7/8-14	6 1/2	1	3 1/2	2 1/16	2	44.80
B106	6	8.1	2 1/2	2	1 1/4	1-14	7 1/2	1	3 1/2	2 1/16	2	65.00
B107	7	9.3	3	2 1/2	1 1/2	1 1/8-12	8 1/2	1	4	2 3/8	2 3/8	70.00
B108	8	10.6	3	3	1 1/2	1 1/4-12	9 1/2	1	4 1/4	2 7/8	2 3/4	75.00

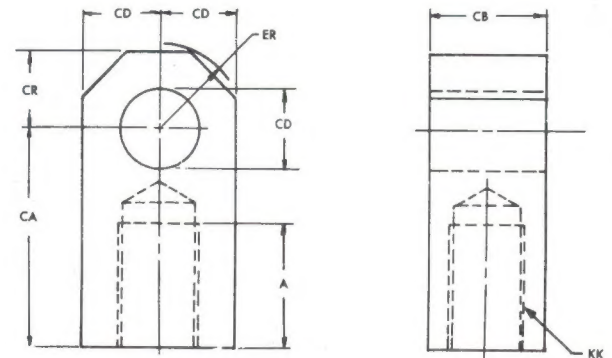
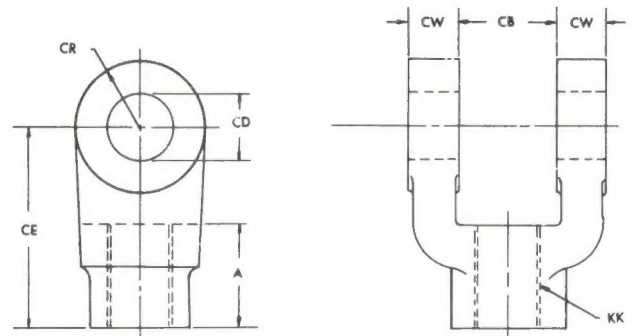
### EYE BRACKET

Part No.	Bore Size	AA	CB	CD	DD	E	F	FL	LR	MR	List Price
B401	1 1/2	2.3	3/4	1/2	1 1/2	2 1/2	3/8	1 1/8	1 1/16	1/2	8.15
B422	2	2.9	1 1/4	3/4	1 1/2	3	5/8	1 7/8	1 1/16	3/4	10.90
B402	2 1/2	3.6	1 1/4	3/4	1 1/2	3 1/2	5/8	1 7/8	1 1/16	3/4	12.50
B403	3 1/4	4.6	1 1/2	1	1 1/2	4 1/2	3/4	2 1/4	1 3/8	1	15.45
B404	4	5.4	2	1 3/8	1 1/2	5	7/8	3	1 7/8	1 3/8	18.30
B405	5	7.0	2 1/2	1 3/4	1 1/2	6 1/2	1	3 1/2	2 1/16	2	29.85
B406	6	8.1	2 1/2	2	1 1/2	7 1/2	1	3 1/2	2 1/16	2	36.15
B407	7	9.3	3	2 1/2	1 1/2	8 1/2	1	4	2 3/8	2 3/8	44.40
B408	8	10.6	3	3	1 1/2	9 1/2	1	4 1/4	2 7/8	2 3/4	66.75

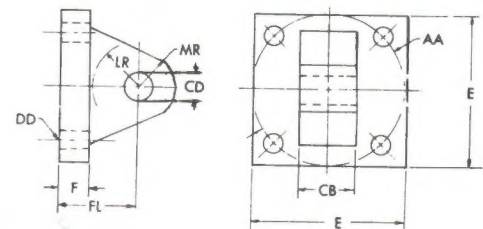
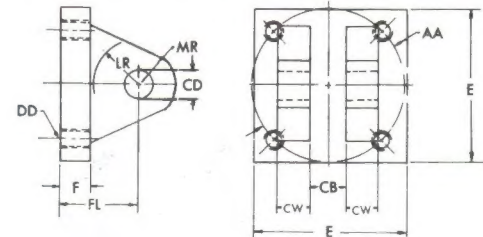
### PIVOT PIN

Part No.	Bore Size	CD	CL	P	List Price
P101	1 1/2	1/2	1 7/8	7/64	1.60
P102	2-2 1/2	3/4	2 5/8	7/64	1.90
P103	3 1/4	1	3 3/8	7/64	2.95
P104	4	1 3/8	4 1/8	7/64	4.15
P105	5	1 3/4	5 1/8	7/64	5.70
P106	6	2	5 3/8	7/64	7.35
P107	7	2 1/2	6 3/8	1 1/64	9.95
P108	8	3	6 3/8	1 1/64	13.75

Pins are Hard Chrome Plated.

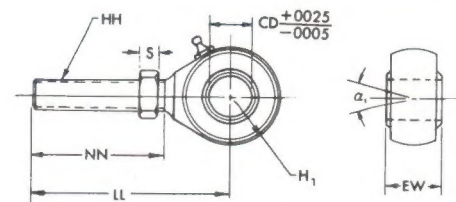


Rod Clevis and Rod Eyes are for use with Milwaukee Style No. 2 Rod End. Match Thread Size when ordering.



### SPHERICAL ROD EYE

Part No.	Bore	α <sub>1</sub>	H <sub>1</sub>	S	CD	EW	HH	LL	NN	H List Price
HS-301	1 1/2	12°	1 1/16	1/4	1/2	5/8	7/16-20	2 7/16	1 15/32	10.30
HS-302	2-2 1/2	13 1/2°	2 9/32	7/16	3/4	7/8	3/4-16	2 27/32	1 23/32	16.40
HS-303	3 1/4	14°	1 13/32	7/16	1	1 3/8	1-14	4 3/32	2 3/32	28.00



NOTE: Use with Style 5 and 3 Rod ends.

**MILWAUKEE CYLINDER CO.**

Division of L & M Machine

5757 S. PENNSYLVANIA AVE.

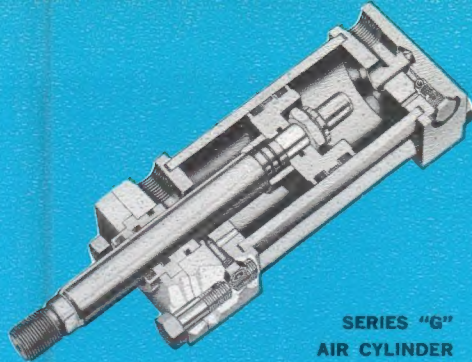
CUDAHY, WISCONSIN

NOTE: Pins are furnished with Model HA Cylinders but must be ordered separately for use with Accessories.

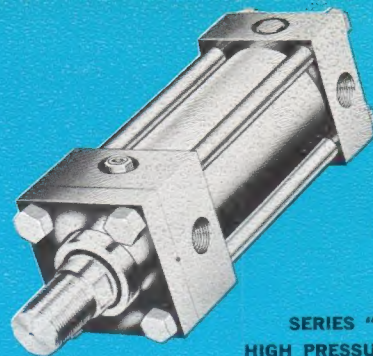
Rod Clevis and Rod Eyes are for use with Milw. style No. 2 rod ends. Match thread size when ordering.



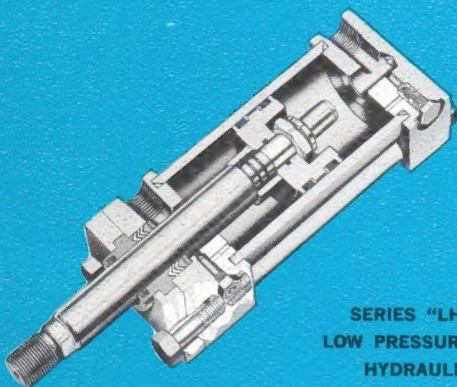
**A  
COMPLETE  
LINE  
OF  
QUALITY  
PRODUCTS**



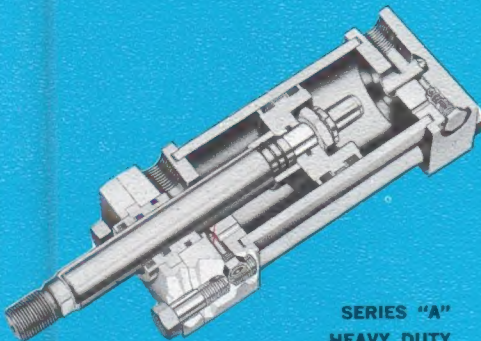
**SERIES "G"  
AIR CYLINDER  
NON-LUBRICATED**



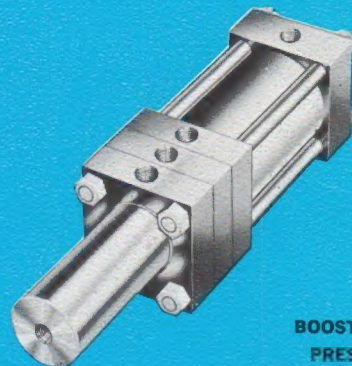
**SERIES "H"  
HIGH PRESSURE  
HYDRAULIC**



**SERIES "LH"  
LOW PRESSURE  
HYDRAULIC**



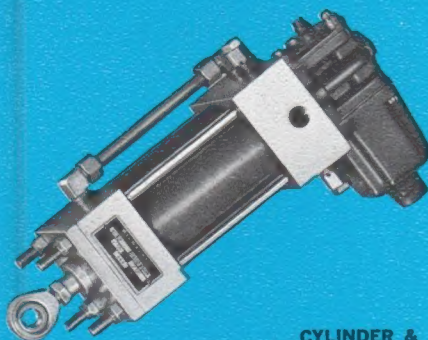
**SERIES "A"  
HEAVY DUTY  
AIR CYLINDER**



**BOOSTERS —  
PRESSURES  
TO 12,000 P.S.I.**



**AIR-OIL  
TANKS**



**CYLINDER &  
VALVE COMBINATIONS**



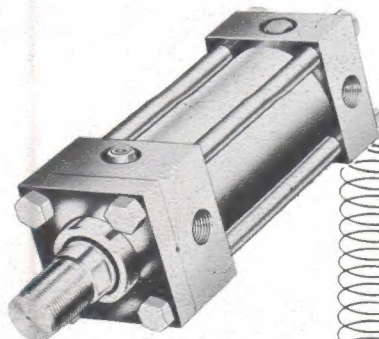
**ACCUMULATORS —  
PRESSURES TO 6,000 P.S.I.**

Milwaukee Cylinder Plant is centrally located in the United States for shipment of cylinders and parts to all points in the country. In addition, extra fast service is available through major freight airlines at General Mitchell Field which is located less than ½ mile from our plant. The Milwaukee Cylinder Company representative in your area is listed in the yellow pages of the telephone directory. You may also write us for the name and location of the nearest 'milwaukee' representative.

**milwaukee**  
*Cylinder*  
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**WARRANTY**

"Milwaukee" products are warranted for one year to be free of manufacturing and material defects. Returned parts, found to be defective will be replaced free of charge including lowest transportation cost, but not including installation cost. Milwaukee products are not warranted for any specific period of time, or specific purpose notwithstanding any disclosure to us of the use to which the specific product is to be put.